

Chapter 6

Electricity

World electricity consumption doubles in the IEO2006 projections from 2003 to 2030. Non-OECD countries account for 71 percent of the projected growth, and OECD countries account for 29 percent.

In the IEO2006 reference case, the world's total net electricity consumption¹¹ doubles, growing at an average rate of 2.7 percent per year, from 14,781 billion kilowatt-hours in 2003 to 21,699 billion kilowatthours in 2015 and 30,116 billion kilowatthours in 2030 (Figure 55). Non-OECD countries account for 71 percent of the projected growth and OECD countries 29 percent.

This chapter examines the future of electricity demand and supply, beginning with a discussion of regional demand and trends anticipated over the 27-year projection period. The remainder of the chapter discusses the projections for electricity generating capacity and electricity generation from competing fuel options. Detailed tables showing regional net electricity consumption, installed generating capacity, fuel use for electricity generation,¹² and generation are included in Appendix F.

Net Electricity Consumption

Projected growth in net electricity consumption is most rapid among the non-OECD economies of the world,

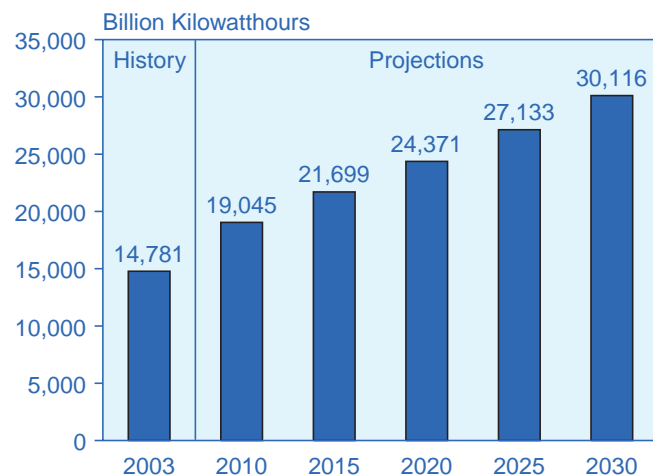
with annual average growth of 3.9 percent from 2003 to 2030 (Figure 56), compared with 1.5 percent for OECD economies. China and the United States lead the growth in annual net electricity consumption with increases of 4,300 and 1,963 billion kilowatthours, respectively, over the projection period.

OECD Economies

In the OECD economies, the electricity sector is well established, and equipment efficiency gains are expected to temper growth in electricity demand. In addition, slower population growth is expected for the OECD economies than for the non-OECD economies; and some European countries, as well as Japan, are expected to see their populations decline. Electricity use in the OECD economies as a whole increases relatively slowly as a result, from 8,823 billion kilowatthours in 2003 to 10,885 billion kilowatthours in 2015 and 13,208 billion kilowatthours in 2030.

In 2003, nearly 60 percent of total net electricity consumption in the OECD economies was in the buildings

Figure 55. World Net Electricity Consumption, 2003-2030

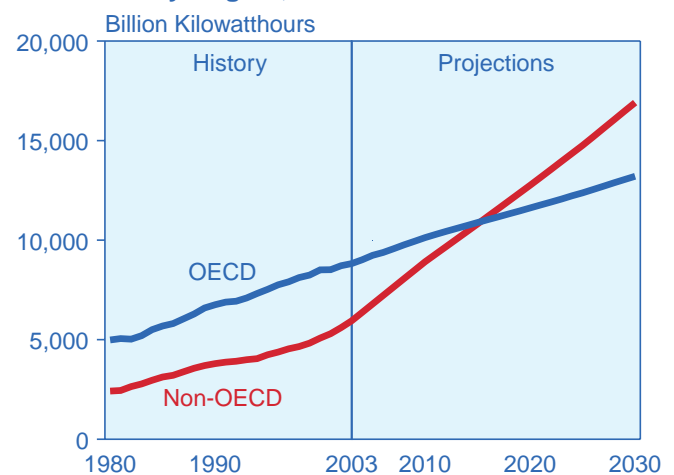


Sources: **2003:** Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2006).

¹¹In IEO2006, "net electricity consumption" equals total electricity generation, plus electricity imports, minus electricity exports, minus electricity used within the power station, minus electricity distribution losses as electricity flows from the power plant to the end user.

¹²In the SAGE model it is possible to distinguish between the electricity generated and heat produced by combined heat and power (CHP) plants; however, it is not possible to determine separately the quantities of each fuel used for electricity generation and for production of heat. Thus, "fuel for electricity generation" also includes fuel that more properly would be attributed to heat production.

Figure 56. World Net Electricity Consumption by Region, 1980-2030



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2006).

sectors (residential and commercial). The remainder was consumed in the industrial sector, except for a small amount (1 percent) used by mass transit trains and buses. The relative shares of electricity consumption by sector do not change by more than 2 percent in the projections (Figure 57). Overall, net electricity consumption in OECD countries increases by 50 percent from 2003 to 2030, mostly as a result of increasing penetration and use of consumer electronics, office equipment, and telecommunications technologies.

In the United States, electricity demand increases from 3,669 billion kilowatthours in 2003 to 5,619 billion kilowatthours in 2030. Demand growth in the commercial sector is particularly strong, averaging 2.2 percent per year. Additions to commercial floorspace, the continuing penetration of new telecommunications technologies, and increased use of office equipment offset efficiency gains for electric equipment in the sector. Moderate increases are projected for electricity consumption in the industrial and residential sectors, averaging 0.8 percent per year and 1.5 percent per year, respectively. A similar pattern is projected for Canada, where net electricity consumption grows from 521 billion kilowatthours in 2003 to 660 billion kilowatthours in 2015 and 776 billion kilowatthours in 2030.

The most rapid growth in net electricity use among the OECD countries is projected for Mexico, averaging 4.1 percent per year overall and 5.8 percent per year in both the residential and commercial sectors. To date, popular opposition in Mexico's Congress and electricity unions to regulatory reform and incentives for private investment has slowed the development of the country's electricity sector [1]; however, such changes will be needed

if growth in the demand for electricity is to be matched by adequate growth in electricity supply.

In OECD Europe, net electricity consumption increases from 2,965 billion kilowatthours in 2003 to 4,107 billion kilowatthours in 2030. OECD Europe's drive to reduce cross-border barriers throughout the regional economy is expected to increase competition in its electricity and natural gas markets, offsetting some of the cost increases resulting from reduced reliance on coal-fired and nuclear power plants and increased reliance on natural gas and renewables for electricity production.

For OECD Asia, projected growth in net electricity consumption is slightly more rapid than it is for OECD Europe, averaging 1.3 percent per year. South Korea leads the increase, with average annual growth of 2.9 percent in industrial electricity consumption, 2.7 percent in residential electricity consumption, and 2.5 percent in commercial electricity consumption.

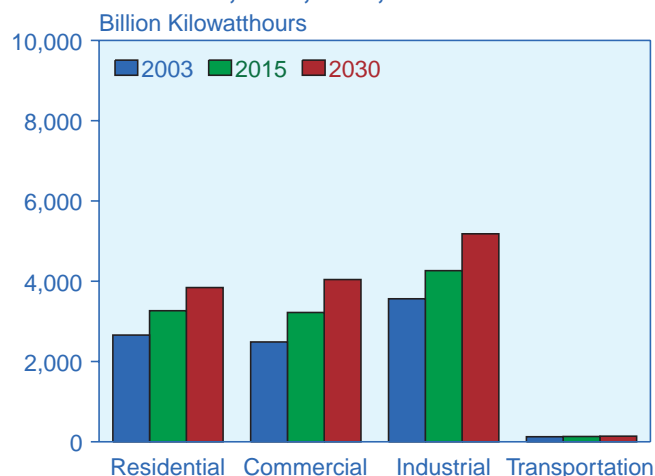
Non-OECD Economies

Electricity consumption in the non-OECD economies grows at an average annual rate of 3.9 percent from 2003 to 2030. Non-OECD Asia has the highest growth rate at 4.7 percent per year, followed by Central and South America at 3.7 percent, the Middle East at 3.0 percent, Africa at 2.9 percent, and non-OECD Europe and Eurasia at 2.8 percent. The average annual growth rates translate to a near tripling of net electricity consumption in the non-OECD nations over the projection period. In 2003, non-OECD economies consumed 40 percent of the world's electricity; in 2030 their share is projected to be 56 percent. Growth in net electricity consumption for the non-OECD economies is driven in large part by assumptions about GDP and population growth.

From 2003 to 2030, residential electricity consumption for the non-OECD economies as a whole grows from 23 percent to 30 percent of total net electricity consumption. In absolute terms, nearly four times as much electricity is consumed in the residential sector in 2030 than was consumed in 2003 (Figure 58), supporting a major transformation in living standards as electric lighting, appliances, and new technologies become available to an increasing share of the world's population. Electricity consumption growth in the non-OECD industrial sector is somewhat slower than in the buildings sectors, despite the rapid adoption of consumer electronics and computers for business use [2, 3]. As a result, the industrial sector share of total non-OECD electricity demand declines from 61 percent in 2003 to 54 percent in 2030, even as industrial electricity use more than doubles.

In non-OECD Europe and Eurasia, electricity demand increases at an average annual rate of 2.8 percent from 2003 to 2030. Many countries in the region are attempting to reform or liberalize their electricity sectors—for the most part to attract much-needed private

Figure 57. Net Electricity Consumption in OECD Countries by End-Use Sector, 2003, 2015, and 2030



Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2015 and 2030:** EIA, *System for the Analysis of Global Energy Markets* (2006).

and foreign investment to repair and expand aging and neglected infrastructure. Net electricity consumption in non-OECD Europe and Eurasia climbs from 1,350 billion kilowatthours in 2003 to 2,850 billion kilowatthours in 2030.

Residential electricity consumption growth in the non-OECD Asia region is by far the fastest in the world, at 6.5 percent per year, driven by population growth and rising living standards. In 2030, residential electricity consumption in the region totals 3,016 billion kilowatthours, or nearly four times its 2003 level. In the commercial and industrial sectors, electricity consumption grows strongly, at average annual rates of 4.8 and 4.0 percent to 1,291 and 5,653 billion kilowatthours, respectively, in 2030. The continuing challenge for the economies of non-OECD Asia will be to develop reliable electricity supplies steadily and avoid shortages or excess capacity.

Other non-OECD regions also show robust growth in demand for electricity in the *IEO2006* reference case. In Africa and the Middle East, annual increases average about 3 percent from 2003 to 2030. Total electricity demand increases to 951 billion kilowatthours in Africa and 1,034 billion kilowatthours in the Middle East. In both regions, most of the demand growth is expected in the industrial and residential sectors. In Central and South America, net electricity consumption increases by 3.7 percent per year on average, to 2,047 billion kilowatthours in 2030, with the residential, commercial, and

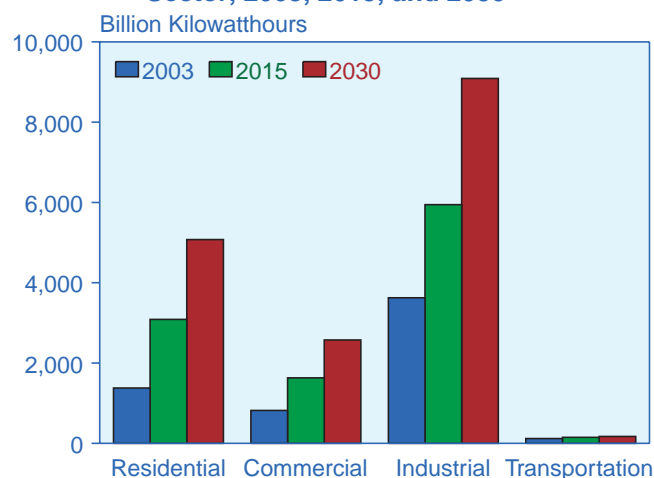
industrial sectors each accounting for approximately one-third of the total.

Electricity Supply

To meet the world's electricity demand over the 2003 to 2030 projection period, an extensive expansion of installed generating capacity will be required. In the reference case, worldwide installed electricity generating capacity grows from 3,710 gigawatts in 2003 to 6,349 gigawatts in 2030, at an average rate of 2.0 percent per year (Figure 59).

The fuels used in the additional generating capacity needed to meet the demand projection in *IEO2006* vary from region to region, as a function of available natural resources, energy security concerns, and market competition among fuel choices (see box on page 66), as well as other factors. Electricity suppliers must decide how much capacity of each generation technology to build, and then they must decide when to use the different types of capacity, balancing the costs and flexibility of the different technologies in their generation fleets. Baseload systems usually are operated over the longest periods and produce the most electricity per unit of installed capacity. For example, in the United States coal-fired steam plants represent 35 percent of the country's installed capacity but 52 percent of its total electricity production. In contrast, natural-gas- and oil-fired units¹³ represent 43 percent of U.S. capacity but only 18 percent of electricity production.

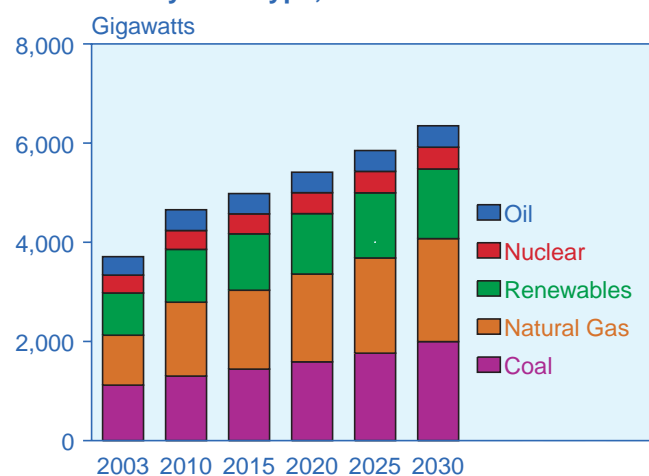
Figure 58. Net Electricity Consumption in Non-OECD Countries by End-Use Sector, 2003, 2015, and 2030



Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2015 and 2030:** EIA, *System for the Analysis of Global Energy Markets* (2006).

¹³Most technologies that generate electricity from natural gas are also capable (with some mechanical modification) of burning oil, with the exception of diesel-fired generators. Therefore, natural-gas- and oil-fired capacity are roughly interchangeable. SAGE model results are used for all regions except the United States, where natural gas and oil "capacities" have been assumed to equal their respective shares of electricity production. Distinctions between natural gas and oil are provided for fuel inputs and the electricity generated from the two fuels.

Figure 59. World Electricity Generating Capacity by Fuel Type, 2003-2030



Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2010-2030:** EIA, *System for the Analysis of Global Energy Markets* (2006).

The mix of primary fuels used to generate electricity has changed a great deal over the past two decades on a worldwide basis. Coal has remained the dominant fuel, although electricity generation from nuclear power increased rapidly from the 1970s through the mid-1980s, and natural-gas-fired generation grew rapidly in the 1980s and 1990s. In contrast, in conjunction with the high world oil prices brought on by the oil price shocks after the oil embargo of 1973-1974 and the Iranian revolution in 1979, the use of oil for electricity generation has been slowing since the mid-1970s. High world oil prices encouraged switching from oil-fired generation to natural gas and nuclear power and reinforced coal's important role in world electric power generation. Similarly, the relatively high fossil fuel prices of recent years are raising renewed interest in nuclear power and making renewable energy sources more competitive economically.

Natural Gas

In the *IEO2006* reference case, natural-gas-fired generating capacity increases by approximately 2.7 percent per year from 2003 to 2030 (Figure 59), as compared with 2.2 percent per year for coal and 1.9 percent per year for renewables. Between 2003 and 2030, 1,070 gigawatts of

natural gas capacity is added worldwide (net of total capacity additions minus capacity retirements), compared with 878 gigawatts of coal-fired generating capacity. As a result, the natural gas share of world installed generating capacity rises from 27 percent in 2003 to 33 percent in 2030. Natural-gas-fired combined-cycle capacity is an attractive choice for new power plants because of its fuel efficiency, operating flexibility (it can be brought on line in minutes rather than the hours it takes for other energy sources like coal), relatively short construction times (months instead of the years that coal or nuclear power plants typically require), and lower investment costs. The major drawback of natural gas capacity is the potential volatility of fuel costs.

At the world level, natural gas consumption increases from 19 percent of total fuel use for electricity generation in 2003 to 22 percent in 2030. Non-OECD economies, on the whole, relied on natural gas for 24 percent of fuel inputs in 2003 and OECD economies for 15 percent. No change is expected for the non-OECD economies, but in the OECD the natural gas share rises to 20 percent in 2030.

In the OECD economies, natural gas and coal each accounted for 28 percent of installed electricity

Technology Choices for New U.S. Generating Capacity: Levelized Cost Calculations

When decisionmakers are faced with the need for new capacity, several technology types can be considered. One of the tools used by decisionmakers is a levelized cost calculation, which incorporates all the expenses and revenues associated with a project over its lifetime. The costs include investment in plant construction, interest charges on funds borrowed to finance the construction, capital outlays after the plant has started operating, taxes, operations and maintenance costs, and fuel costs. The levelized cost calculation balances those expenses against estimates of revenues over the life of the plant, including proceeds from power sales and a desired rate of return on the investment. The streams of expenses and revenues are expressed as a real annuity, where the payments are assumed to be for the same dollar amount in every year of the plant's life.

Levelized cost comparisons give investors one basis for choosing a technology. In addition, other factors are considered, such as the operating characteristics of different technologies. For example, intermittent technologies like wind and solar produce less power over time than do coal, nuclear, or combined-cycle natural gas plants. There may also be tradeoffs between capital costs and fuel costs. Nuclear generators are expensive to build, but their fuel and operating costs are low; combined-cycle plants are far less expensive to build, but their fuel and operating costs are much higher.

An illustration of levelized cost calculations for a typical coal plant, an advanced combined-cycle natural gas plant, a wind plant, and a nuclear plant to be built in the United States is shown in the table below. The cost estimates are based on assumptions used in EIA's *Annual Energy Outlook 2006*, expressed in 2004 dollars per megawatthour. For U.S. plants that would begin operation in 2015, the combined-cycle plant is the least-cost option and the nuclear plant the most expensive.

Levelized Cost Comparison for New Generating Capacity in the United States
(2004 Dollars per Megawatthour)

Cost Element	Technology			
	Coal	Natural Gas	Wind	Nuclear
Capital . . .	30.4	11.4	40.7	42.7
O&M	4.7	1.4	8.3	7.8
Fuel	14.5	36.9	0.0	6.6
Total^a . .	53.1	52.5	55.8	59.3

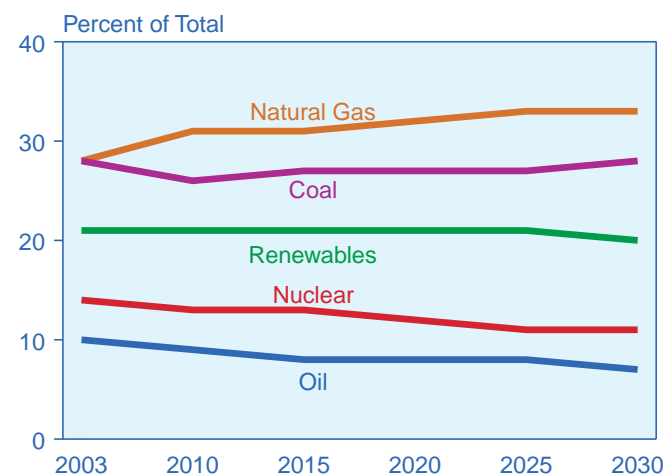
^aIncludes transmission hookup costs.
O&M = operations and maintenance.
Source: Energy Information Administration, *Annual Energy Outlook 2006*, DOE/EIA-0383(2006) (Washington DC, February 2006).

generating capacity in 2003 (Figure 60). Over the projection period, natural gas capacity gains share (rising to 33 percent) at the expense of nuclear, renewables, and oil-fired capacity, while coal's share remains steady. Nearly one-half of the total increment in OECD natural-gas-fired generating capacity is attributed to the countries of Europe, where the natural gas share of electric power generation more than doubles, from 15 percent in 2003 to 39 percent in 2030. With planned phaseouts of nuclear generators in Belgium, Germany, and Sweden and disincentives for construction of new coal-fired capacity because of environmental restrictions, natural gas gains the largest share of the OECD Europe electricity market.

In the United States, both the share of natural gas capacity and the share of electricity generated from natural gas decline over the projection period. Natural-gas-fired plants, which provided 15 percent of total U.S. electricity supply in 2003, increase their share to 20 percent of supply in 2015 before dropping back to 15 percent in 2030. Natural-gas-fired generation (excluding generation in the industrial sector) increases initially as the recent wave of newer, more efficient plants come online, but it declines toward the end of the projection period as natural gas prices continue to rise [4]. A similar pattern of expanding natural gas capacity and generation shares, followed by declining shares relative to other fuels, is expected in OECD Asia. In both Canada and Mexico, natural gas capacity increases steadily, and natural-gas-fired generation increases by 4.5 percent per year in Canada and 6.9 percent per year in Mexico.

In the non-OECD nations, the natural gas share of total electricity generation rises as oil and renewables lose

Figure 60. Shares of OECD Installed Electricity Capacity by Fuel Type, 2003-2030



Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2010-2030:** EIA, System for the Analysis of Global Energy Markets (2006).

share. Natural-gas-fired capacity grows most rapidly in non-OECD Asia—especially China and India—and natural gas consumption in the electric power sector increases by an average of 7.0 percent per year in China and 7.1 percent per year in India from 2003 to 2030. For non-OECD Asia as a whole, natural-gas-fired electricity generation increases by an average of 7.2 percent per year, as compared with 4.7 percent per year worldwide.

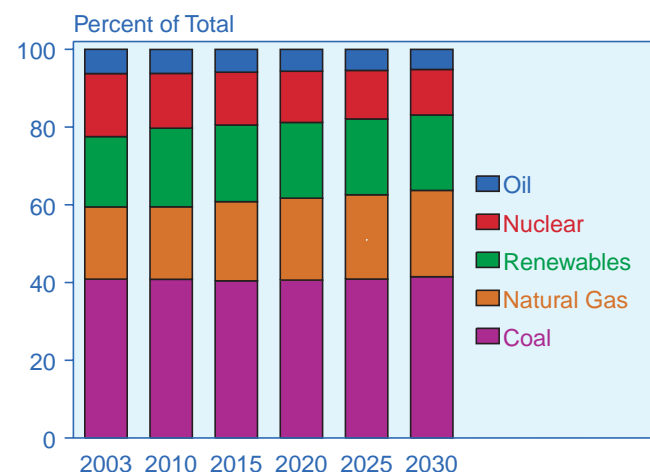
In non-OECD Europe and Eurasia, with access to rich natural gas resources, natural gas was used for 35 percent of total electricity generation in 2003. In 2030, its share of the region's electricity production is projected to be 60 percent. Africa, the Middle East, and Central and South America also rely increasingly on natural gas to produce electricity in the reference case.

Coal

Coal retains the largest market share of the world's electricity generation (roughly 40 percent) in the *IEO2006* reference case, despite losing some of its share to natural gas (Figure 61). Installed coal-fired capacity, as a share of total world capacity, remain at about 30 percent. Worldwide, coal-fired capacity grows by 2.2 percent per year, from 1,119 gigawatts in 2003 to 1,997 gigawatts in 2030 (Figure 62)—slightly faster than the 2.0-percent average annual increase for all electricity generation capacity. In 2003, non-OECD economies on the whole relied on coal for roughly 43 percent of generation, slightly more than the OECD economies.

Regional differences in coal use for electricity generation arise primarily from differences in coal resources.

Figure 61. Fuel Shares of World Electricity Generation, 2003-2030



Note: Fuel shares may not add to 100 percent due to independent rounding.

Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2010-2030:** EIA, System for the Analysis of Global Energy Markets (2006).

Regions with large coal resources are more likely to use coal for electricity generation, because coal has a lower energy density (energy per weight) and fewer alternative uses than oil or natural gas. These factors help keep coal prices, on an energy basis, lower than oil and natural gas prices. Coal reserves in the United States, China, India, and Australia are among the largest in the world, and those countries rely on coal to generate 50 to 80 percent of their electricity.

China and the United States lead the world in coal-fired capacity additions in the projections, adding 546 gigawatts and 154 gigawatts, respectively. In China, strong growth in natural-gas-fired capacity initially pushes coal's share of total capacity down to 63 percent in 2010, but it rebounds to 72 percent in 2030. In the United States, coal-fired power plants continue supplying the largest share of electricity generation through 2030 [5]. Sustained high world oil and natural gas prices in the *IEO2006* reference case lead to increased reliance on coal to produce electricity in the later years of the projection. The coal share of total electricity generation in the United States increases from 53 percent in 2003 to 57 percent in 2030. In non-OECD Asia excluding China, the share of electricity generated from coal-fired capacity declines, despite continuing additions to coal-fired capacity, because additions of natural-gas-fired capacity exceed additions to coal-fired capacity. In all other regions, the coal share of electricity generation remains stable or falls.

Oil

Although relatively little change in oil-fired generating capacity is expected, oil's share of world installed capacity declines over the projection period, from 10 percent

in 2003 to 7 percent in 2030. Oil has more value in the transportation sector and in limited applications for distributed diesel-fired generators than in central power plant applications. Only the Middle East and China are expected to see sizable increases in oil-fired electric power capacity over the projection period, adding 24 and 22 gigawatts, respectively.

In recent years, China has shown fairly strong growth in oil-fired electricity generation, because peak electricity demand continues to outpace on-grid electricity generation, and Chinese industry has had to rely on diesel generators to cope with annual summer power shortages. That situation is expected to continue in the short term, but as planned capacity fueled by natural gas, coal, nuclear, and hydropower comes on line and the country's national electricity grid matures, the use of oil to generate electricity is expected to moderate.

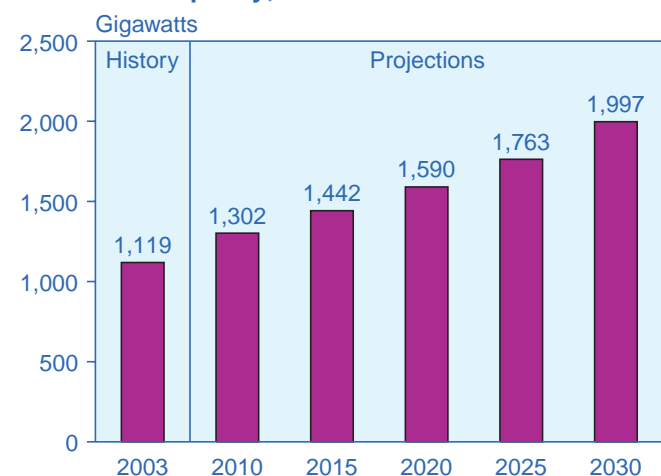
Nuclear Power

The world's nuclear-powered generating capacity increases in the *IEO2006* reference case from 361 gigawatts in 2003 to 438 gigawatts in 2030, in contrast to projections of declines in nuclear power capacity in past *IEOs*. The reference case is based on existing laws and assumes that, for the OECD economies in the long term, retirements of existing nuclear power plants as they reach the end of their operating lives will nearly equal construction of new nuclear power capacity, resulting in a slight decline of installed nuclear capacity toward the end of the projection after peaking in 2020. Few new builds are expected in the OECD economies outside of Finland, France, Japan, South Korea, and the United States. In the United States, nuclear capacity is expected to increase by 3 gigawatts as a result of uprates at existing plants and by 6 gigawatts as a result of new construction [6].

In contrast, rapid growth in nuclear power capacity is projected for the non-OECD economies (Figure 63). The non-OECD economies are expected to add 33 gigawatts of nuclear capacity between 2003 and 2015 and another 42 gigawatts between 2015 and 2030. The largest additions are expected in China, India, and Russia.

Prospects for nuclear power have improved in recent years, with higher capacity utilization rates reported for many existing nuclear facilities and the expectation that most existing plants in the OECD nations and in non-OECD Europe and Eurasia will be granted extensions to their operating lives. Higher fossil fuel prices, concerns about energy supply security, and the possibility for new, lower cost nuclear reactor designs also may improve prospects for new nuclear power capacity. Nevertheless, nuclear power trends can be difficult to anticipate for a variety of political and social reasons, and considerable uncertainty is associated with nuclear power projections.

Figure 62. World Installed Coal-Fired Generating Capacity, 2003-2030



Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2010-2030:** EIA, *System for the Analysis of Global Energy Markets* (2006).

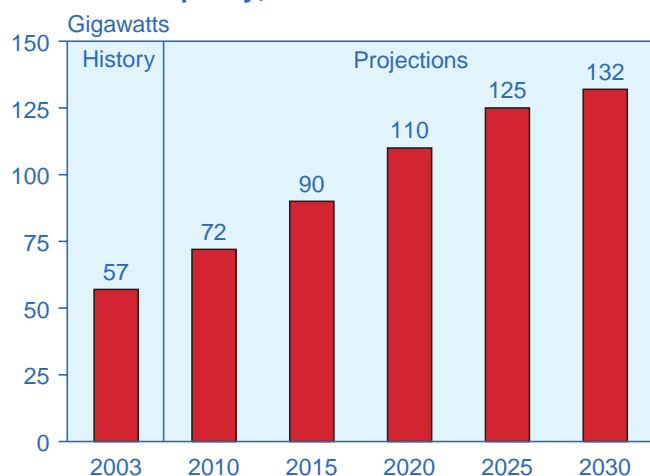
Nuclear power is an important source of electricity in many countries of the world. In 2005, 16 countries depended on nuclear power for at least 25 percent of their electricity generation (Figure 64). As of December 2005, there were 443 nuclear power reactors in operation around the world, and another 24 were under construction. Despite a declining share of global electricity production, nuclear power is projected to remain an important source of electric power through 2030. In the *IEO2006* reference case, electricity generation by nuclear power plants around the world increases from 2,523 billion kilowatthours in 2003 to 2,940 billion kilowatthours in 2015 and 3,299 billion kilowatthours in 2030.

Hydroelectricity and Other Renewables

Grid-connected hydroelectric and other generating capacity fueled by renewable energy resources is projected to increase by 553 gigawatts from 2003 to 2030, at an average annual rate of 1.9 percent. High oil and natural gas prices, which are expected to persist in the mid-term projection, encourage the penetration of renewables. Renewable generating capacity in 2025 is 18 percent higher in *IEO2006* than was projected in the *IEO2005* reference case (the *IEO2005* projection period ended at 2025). Nonetheless, the renewable share of world installed capacity falls slightly, from 23 percent in 2003 to 22 percent in 2030, as natural gas continues to gain market share in many regions of the world.

Much of the projected growth in renewable generation results from the expected completion of large hydroelectric facilities in non-OECD Asia, where the need to expand electricity production with associated dams and reservoirs often outweighs concerns about environmental impacts and the relocation of populations. China has

Figure 63. Non-OECD Installed Nuclear Generating Capacity, 2003-2030

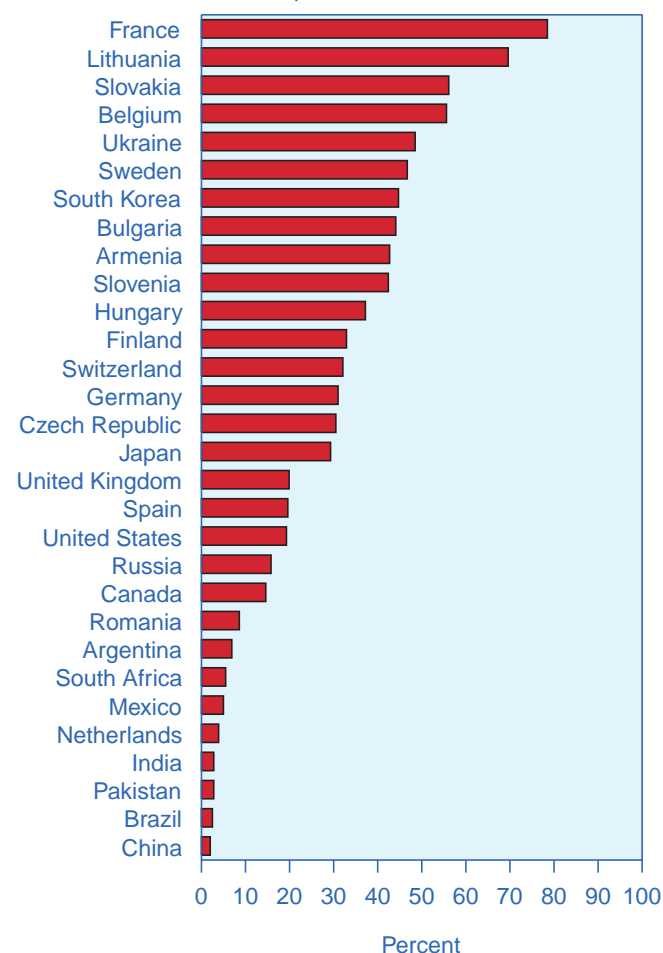


Sources: **2003:** Derived from Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2010-2030:** EIA, System for the Analysis of Global Energy Markets (2006).

ambitious plans to increase hydroelectric capacity, including completion of the 5.4-gigawatt Longtan hydroelectric project by the end of 2007 and the 18.2-gigawatt Three Gorges Dam project in 2009 [7]. India and several other non-OECD Asian countries, including Laos and Vietnam, also have plans to increase hydroelectric capacity [8].

In Central and South America, many nations have plans to expand their already well-established hydroelectric resources. Brazil is the largest energy market in Central and South America, and more than 80 percent of its electricity generation comes from hydroelectric sources. As a result, Brazil is especially vulnerable to drought-induced shortages in electricity supply. In general, the nations of Central and South America are not expected to expand hydroelectric resources dramatically but instead are expected to invest in other sources of electricity—particularly natural-gas-fired capacity—that will allow them to diversify electricity supplies and reduce their reliance on hydropower.

Figure 64. Nuclear Shares of National Electricity Generation, 2005



Source: International Atomic Energy Agency, Reference Data Series 2, "Power Reactor Information System," web site www.iaea.org/programmes/a2/ (April 2006).

In the OECD, grid-connected installed renewable capacity is projected to increase by 0.8 percent per year over the 2003 to 2030 period. Hydroelectric capacity in OECD economies is not expected to grow substantially, and only Canada is expected to complete any sizable hydroelectric projects over the projection. Nonhydropower renewables are instead expected to lead the growth in renewable generating capacity, especially wind in OECD Europe and the United States, where wind-powered generating capacity increased by 18 percent and 27 percent, respectively, in 2005 alone [9].

The *IEO2006* projections for hydroelectricity and other renewable energy resources include only on-grid renewables. Non-marketed (noncommercial) biofuels from plant and animal sources are an important source of energy, particularly in non-OECD economies, and the International Energy Agency has estimated that some 2.4 billion people in developing countries depend on traditional biomass for heating and cooking [10]. Because comprehensive data on the use of non-marketed fuels and dispersed renewables (renewable energy consumed on the site of its production, such as solar panels used to heat water) are not available, they are not included in the projections; however, both non-marketed fuels and dispersed renewables are considered in formulating end-use energy demands.

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